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A Discourse concerning the Modern Theory of Generation; by Dr. George Garden of Aberdeen, being part of a Letter to Dr. William Mufgrave, LL. D. Reg. Soc. S. and by him communicated to the Royal Society.

THE Subject I pitch upon, is that of the formation of Animals. You know how wide and unsatisfying Mens Conjectures were upon this Head until this Age, in which first the deservedly Famous Dr. *Harvey* discovered the proper place of the formation of the Chick in the *Cicatricula* of the Egg, and the formation of the Parts so far as was discernable by the naked Eye; and after him *Malpighius* by the help of exact Glasses, observed the first Rudiments of it there, both before and after Incubation: And *R. de Graef* and others, having upon many Observations concluded that the *Testes Fœminei* were the Ovaries of Females, and consequently that all Animals were *ex ovo*; they began from hence to infer, that the Rudiments of each Animal were originally in the respective Females, and that the Male contributed only to give a new Ferment to the Mass of the Blood and Spirits, by which means a spirituous Liquor (which the Blood in its ordinary Ferment could not produce) did insinuate its self into the same Ducts and Pores of the Rudiments of those Animals which were in greatest forwardness in the Ovary, and so extend, and enlarge all their Parts, and at last bring them to perfection, as Mr. *Perrault* does ingeniously discourse in the third Part of his *Essais de Physique*; till now at last *Leeuwenhoeck* has discovered an infinite number of *Animalcula in semine marium* of all Kinds, which has made him condemn the former Opinions about the propagation of all Animals *ex Ovo*.

Now upon comparing the Observations and Discoveries which have been made with one another; these
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three things seem to me very probable. 1. That Animals are *ex Animalculo*. 2. That these Animalcles are originally in *semine Marium & non in Fœminis*. 3. That they can never come forward, nor be formed into Animals of the respective kind, without the *Ova in fœminis*.

The first of these seems probable from these three Observations. 1. That some such Thing has been so often observed by *Malpighius* in the *Cicatricula* of an Egg before Incubation, as the Rudiments of an Animal in the shape of a Tadpole, as may be seen in his first, and in his repeated Observations *de formatione Pulli in Ovo*. 2. The sudden appearance and displaying of all the Parts after Incubation makes it probable, that they are not then actually formed out of a Fluid, but that the *Stamina* of them have been formerly there existent, and are now expanded. The first part of the Chick which is discovered with the naked Eye is, you know, the *Punctum saliens*, and that not till three days and nights of Incubation be past, and then on the fifth day the Rudiments of the Head and Body do appear. This made *Dr. Harvey* conclude that the Blood had a being before any other part of the Body, and that from it all the Organs of the *Fœtus* were both form'd, and nourished; but by *Malpighius's* Observations we find that the Parts are then only so far extended as to be made visible to the naked Eye, and that they were actually existent before, and discernable by Glasses. After an Incubation of thirty hours are to be seen the Head, the Eyes, and the *Carina*, with the *Vertebræ*, distinct, and the Heart. After forty hours its Pulse is visible, and all the other Parts more distinct, which cannot be discerned by the naked Eye before the beginning of the fifth day; from whence it seems very probable, that even the so early discovery of those Parts of the *Fœtus* by the Microscope, is not the discerning of Parts newly form'd, but only more dilated and extended by receiving of Nutri-
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ment from the *Colloquamentum* ; so that they seem all to have been actually existent before the Incubation of the Hen. And what *Swammerdam* has discovered in the transformation of Insects, gives no small light to this, whilst he makes appear in the Explanation of the 13th Table of the General History of Insects, that in those large *Eruca's* which feed upon Cabbage, if they be taken about the time they retire to be transform'd into *Aurelia's*, and plunged often in warm Water to make a Rupture of the outer Skin, you will discern through the Transparency of their second Membrane, all the Parts of the Butterfly, the Trunk, Wings, Feelers, &c. folded up. But that after the *Eruca* is chang'd into an *Aurelia*, none of these Parts can be discerned, they are so drencht with moisture, though they be there actually form'd. Another Consideration is from the Analogy, which we may suppose between Plants and Animals. All Vegetables we see do proceed *ex Plantula*, the Seeds of Vegetables being nothing else but little Plants of the same kind folded up in Coats and Membranes : and from hence we may probably conjecture that so curiously an organized Creature as an Animal, is not the sudden product of a Fluid or *Colliquamentum*, but does much rather proceed from an Animalcle of the same kind, and has all its little Members folded up according to their several Joynts and Plicatures, which are afterwards enlarged and distended, as we see in Plants. Now though this Consideration alone may seem not to bear much weight, yet being joyn'd to the two former they do mutually strengthen each other. And indeed all the Laws of Motion which are as yet discovered, can give but a very lame account of the forming of a Plant or Animal. We see how wretchedly *Des Cartes* came off when he began to apply them to this Subject ; they are form'd by Laws yet unknown to Mankind, and it seems most probable that the *Stamina* of all the Plants and Animals that have been, or ever shall

shall be in the World, have been formed *ab Origine Mundi* by the Almighty Creator within the first of each respective kind. And he who considers the nature of Vision, that it does not give us the true magnitude, but the proportion of Things, and that what seems to our naked Eye but a Point, may truly be made up of as many Parts as seem to us to be in the whole visible World, will not think this an absurd or impossible thing.

But the second thing which later discoveries have made probable is, that these Animalcules are originally in *Semine Marium & non in feminis*. And this I Collect from these Considerations. 1. That there are innumerable *Animalcula* discovered in *Semine Masculi omnium Animalium*. Mr. *Leeuwenhoeck* has made this so evident by so many Observations, that I do not in the least question the truth of the thing. The reason of their multitude, and some of the difficulties which arise thereupon, he has cleared to very good purpose, so that I shall not repeat them. 2. The observing the Rudiments of the *Fœtus* in Eggs, which have been fecundated by the Male, and the seeing no such thing in those which are not fecundated, as appears from *Malpighius* his Observations, make it very probable that these Rudiments proceed originally from the Male, and not from the Female. 3. The resemblance between the Rudiments of the *fœtus in Ovo*, both before and after Incubation, and the *Animalcule*, makes it very probable that they are one and the same. The same shape and figure which Mr. *Leeuwenhoeck* gives us of the *Animalcule*, *Malpighius* likewise gives of the Rudiments of the *Fœtus*, both before and after Incubation, yea, and even the *Fœtus*'s of Animals do appear so at first to the naked Eye, so that Dr. *Harvey* does acknowledge that all Animals, even the most perfect are begotten of a Worm, *De Gen. Anim. Ex. 13.* 4. This gives a rational account of many *Fœtus*'s at one Birth, especially that of the Countess of Holland,

Holland, and how at least a whole Cluster of Eggs in a Hen are fecundated by one Coition of the Male. 5. This gives a new light as it were to the first Prophecy concerning the *Messiah*, that the Seed of the Woman shall bruise the Head of the Serpent, all the rest of Mankind being thus most properly and truly the Seed of the Man. 6. The Analogy I have already mentioned, which we may rationally suppose between the manner of the propagation of Plants and Animals, does likewise make this probable. Every Herb and Tree bears its Seed after its kind, which Seed is nothing else but a little Plant of the same kind, which being thrown into the Earth, as into its *Uterus*, spreads forth its Roots and receives its nourishment, but has its form within its self, and we may rationally conjecture some such Analogy in the Propagation of Animals.

The third Particular which later Discoveries make probable, is that Animals cannot be form'd of these *Animalcula* without the *Ova in feminis*, which are necessary for supplying of them with proper Nutriment: And this these Considerations seem to evince. 1. It is probable that an Animalcle cannot come forward if it do not fall into a proper *Nidus*. This we see is the *Cicatricula* in Eggs, and tho' a Million of them should fall into an Egg, none of them would come forward, but what were in the Center of the *Cicatricula*, and perhaps the *Nidus* necessary for their formation is so proportion'd to their bulk, that it can hardly contain more than one Animalcle; and this may be the reason why there are so few Monsters. This we see is absolutely necessary in *Oviparis*, and the only difference which seems to be between them and the *Vivipara* in this matter is in this, that in the latter the *Ova* are properly nothing more but the *Cicatricula* with its *Colliquamentum*, so that the *Fœtus* must spread forth its roots into the *Uterus* to receive its nourishment; but the Eggs in *Oviparis* may be properly term'd an *Uterus*
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in relation to the *Fætus*; for they contain not only the *Cicatricula* with its *Amnion* and the *Colliquamentum*, which is the immediate nourishment of the *Fætus*; but also the materials which are to be converted into that *Colliquamentum*, so that the *Fætus* spreads forth its roots no farther than into the white and yolk of the Egg, from whence it derives all its nourishment. Now that an Animalcle cannot come forward without some such proper *Nidus*, Mr. *Leewenhoek* will not readily deny; for if there were nothing needful but their being thrown into the *Uterus*, I do not see why many hundreds of them should not come forward at once; for as to what Mr. *Leewenhoek* says, that one of them would bedwarf and choak the rest; this might fall out in process of time: but at first I do not see why many of them should not grow together, whilst scattered in so large a Field: (and yet no such thing is observed) if there were not an absolute necessity of a *Cicatricula* for their growth and thriving. Now, 2. That this *Cicatricula* is not originally in *Utero*, seems evident from the frequent Conceptions which have been found *extra Uterum*: Such as the Child which continued twenty six Years in the Woman of *Thoulouse's* Belly, mentioned *Numb. 139.* of the *Phil. Transf.* And the little *Fætus* found in the *Abdomen de St. Mere*, together with the Testicle torn and full of clotted Blood recorded *Numb. 150.* both taken out of the *Journals des Scavans*: Such also seem to be the *Fætus* in the *Abdomen* of the Woman of *Copenhagen*, mentioned in the *Nouvelles des Lettres*, for *Sept. 85. pag. 996.* all the Members of which were easily to be felt through the Skin of the Belly, and which she had carried in her Belly for four Years; And the seven Years Gravitation related by Dr. *Cole*, *Numb. 172.* of the *Transact.* That these two were undoubtedly *extra Uterum* is uncertain, because the last was not opened after her death, and the former may be yet still alive. Now granting

ing once the necessity of a proper *Nidus* for the formation of an Animalcle into the Animal of its respective kind; these Observations make it probable that the *Testes* are the *Ovaria* appropriated for this use; for though the Animalcles coming thither in such Cases may seem to be extraordinary, and that usually the Impregnation is *in Utero*; yet it may be collected from hence, that the *Cicatriculæ* or *Ova* to be impregnated are in *Testibus fæmineis*; for if it were not so, the accidental coming of Animalcles thither could not make them come forward more than in any other part of the Body, since they cannot be formed and nourished without a proper *Nidus*. But, 3. It is acknowledged by all, that the *Fætus in Utero* for some considerable time after Conception has no Connexion with the Womb, that it sits wholly loose to it, and is perfectly a little round Egg with the *Fætus* in the midst, which sends forth its Umbilical Vessels by degrees, and at last lays hold on the *Uterus*. Now from hence it seems evident, that the *Cicatricula*, which is the Fountain of the Animalcles nourishment, does not sprout from the *Uterus*, but has its *Origine* elsewhere, and falls in thither as into a fit Soil from whence it may draw Nutriment for the growth of the *Fætus*: else it cannot be easily imagined how it should not have an immediate Connexion with the *Uterus* from the time of Conception. If you joyn all these three Considerations together, *viz.* that an Animalcle cannot come forward without a proper *Nidus* or *Cicatricula*; that there have been frequent *Fætus's extra Uterum*; and that they have no *Adhesion* to the *Uterus* for a considerable time after Conception, they seem to make it evident that Animals cannot be form'd *ex Animalculis* without the *Ova in Fæminis*. To all these I shall subjoyn the proposal of an *Experimentum Crucis*, which may seem to determine whether the *Testes Fæminæ* be truly the *Ovaria*, *viz.* Open the *Abdomen* of the Females of some kinds, and cut out these

these Testicles, and this will determine whether they be absolutely necessary for the formation of Animals.

There are some difficulties proposed against this Conjecture, which I think may be easily resolved. Some object the distance between the *Tubæ* or *Cornua Uteri* and the Testicles; but to this is opposed by *Swammerdam* and others, the like distance between the *Infundibulum*, in Hens and Frogs, and the Ovary, and yet it cannot be denied that the Eggs are transmitted through this into the *Uterus*: and besides *R. de Graef*, and others, have by repeated Observations found that the *Cornua Uteri* do at certain times after Conception, embrace the *Testes* on both sides the *Uterus*. They object in the second place the great disproportion between the pretended Eggs in the Ovary, and the Aperture of the *Tubæ* or *Cornua Uteri*, the former being a great deal bigger than the latter: but both *R. de Graef* and *Malpighius* have cleared that matter by making appear, that these Bladders in the Ovary are not the *Ova*, but serve to form the *Glandules* within which the *Ova* are formed, which break through a small *Papilla* opening in the *Glandule*, which bears a proportion to the Aperture of the Tube. They object, 3. The difficulty to conceive how these Eggs should be impregnated *per semen Maris*, both because there is no Connexion between the *Tubæ* and the Ovary for its transmission, and for that *Dr. Harvey* could never discover any thing of it in *Utero*. As to the last, *Mr. Leewenhoek* has cleared that difficulty by the discovery of innumerable *Animalcule Seminis Maris in Cornubus Uteri*, and those living a considerable time after Coition. *Numb. 174. of the Transact.* And as to the former we may either suppose that there is such an Inflation of the *Tubæ* or *Cornua uteri tempore Coitionis*, as makes them embrace the *Ovaria*, and such an approach of the *Uterus* and its *Cornua*, as that it may easily transmit the Seed into the Ovary; or else that the *Ova* are impregnated by the

Animalcles after they descend into the *Uterus*, and not in the Ovary; the former seems probable for this reason, that at least a whole Cluster of Eggs in a Hen will be fecundated by one tread of the Cock; now this Fecundation seems to be in the Vitellary, and not in the *Uterus*, as the Eggs pass along from day to day, for it can hardly be supposed that the Animalcles should subsist so long, being scattered loosely in the *Uterus*, as to wait there for many days for the fecundation of the Eggs as they pass along. The latter conjecture has this to strengthen it, that the Animalcles are found to live a considerable time in the *Uterus*, and that if they should impregnate the *Ova* in the Ovary it self, the *Fetus* would increase so fast, that the *Ova* could not pass through the *Tubæ Uteri*, but would either burst the Ovary, or fall down into the Abdomen from the Orifices of the *Tubæ*; and that from hence proceed those extraordinary Conceptions in *Abdomine extra Uterum*. But, 4. Mr. *Leeuwenhoek*, Numb. 147. of the *Transact.* to weaken the third Consideration about the Conceptions being like unto an *Ovum* in the Womb, proposes a Parallel between these Animalcles and Insects, and insinuates that as the latter cast their Skins and appear of another shape, so the other which at first seem like Tadpoles, may cast their outer Skin and then be round, and that this may be the occasion of the round Figure of the Conception in the Womb. To this it may be replied, that according to Mr. *Leeuwenhoek*'s own sentiment, the Animalcles cannot come forward if they do not find the *Punctum* or proper place for their nourishment, to which it seems they must have some *Adhesion*. Now the Conception in *Viviparis* is not fastned unto the Womb for many days, nor does adhere to any point of it, so that it seems this roundish Body is not the Animalcle thus chang'd after having cast an outer Skin, but is rather the *Cicatricula* or little Egg, into which the Animalcle has entred as its

Punctum

Punctum or place of nourishment: Else I do not see why they should not be adhering to the Womb from the first Conception, or why (as I have said) many hundreds of them are not conceived and formed together, &c.

Observatio Mercurii sub Sole visi, ultimo Octobris 1690.
 Stil. vet. habita Noribergæ ab Astronomo accuratissimo
 Johanne Phil. Wurtzelbaur, atque ab eodem cum Reg.
 Societate communicata.

Mercurius sub Sole inque ejus disco, hoc seculo vix aliquoties ope Telescopii, ante hujus inventionem autem ab orbe condito nusquam gentium observatus est. Sub finem Octobris labentis hujus anni denuò observandum ex. Tabb. Rudolphinarum calculo celeberrimi Logistæ predixerunt. Cum verò nemo qui delicias Urania vel primis degustârit labris, rarissimum hujusmodi & jucundissimum Phenomenon contueri non summa aviditate exoptâret: eo ipso & ego invitatus illi observando invigilare decrevi, nihil morans, quòd cælum jam ab aliquot septimanis nube serè continuâ obductum vix aliquid spei successus optati concesserit: Præcedentis equidem diei vespera noctisq; primordia nubes aliquantulum dissipârunt, sed nox adulta Cælum ab omni parte denuò obvelavit, ut hora ante Solis exortum totum obductum extiterit, nec ipsemet Sol jam satis elevatus suis radiis invidos hosce vapores penetrare valuerit: Paulò verò postquam Zephyri à parte occidentâ Horizontem repurgare ceperunt, ingruent illinc serenitas addidit animum, ut voti competeret futurum haud amplius desperaverim; nubes etiam in plagâ orientali retro cedere, & ad Horizontem constipari videns, Tuum illò ubi emersio Solis è nebulis expectanda erat direxi;